Testimony

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INTRODUCTION

Good morning, Mr. Chairman and members of the Committee. My name is Robert E. Skinner, Jr. I am the Executive Director of the Transportation Research Board (TRB) of the National Academies. TRB is one of the five divisions of the National Research Council (NRC), which, in turn, is the operating arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine. This complex of organizations is collectively referred to as the National Academies. The institution operates under the charter given to the National Academy of Sciences by Congress in 1863 to advise the government on matters of science and technology.

From the 1920s until 1975, my organization was named the Highway Research Board. In 1975 the organization became multi-modal and was renamed the Transportation Research Board. TRB's mission is to promote innovation and progress in transportation through research. It is best known for its role in promoting innovation and information exchange by maintaining approximately 200 standing technical committees in all modes of transportation and hosting an Annual Meeting that attracts more than 10,000 participants from the United States and around the world. TRB also conducts policy studies for Congress and the executive branch, and is increasingly called upon to administer research programs for others that are stakeholder-directed and primarily award research funding based on competition and merit review by peers.

The testimony I will give today is based upon the work of expert committees, appointed by the NRC, and serving without compensation to carry out projects for the Federal Highway Administration's (FHWA) research and technology programs and the Research and Innovative Technology Administration (RITA). I have cited these different reports throughout my testimony, and they are listed at the end of this document.

We also have committees at work reviewing the research programs of the Federal Railroad and Federal Transit Administrations, and TRB manages cooperative research programs for transit agencies and airports. I have not addressed these modes in my written testimony in any detail but will be happy to comment on these activities if

requested. I emphasize highway research programs in my testimony, but most of the lessons drawn are applicable and transferable to research in other modes.

Importance of Highways

The American lifestyle is absolutely dependent on highway transportation. Americans use personal vehicles for 87 percent of daily trips and 90 percent of long distance trips. The decentralized U.S. economy would be unimaginable without the access that highways provide for motor carriers. Truck ton-miles represent about 30 percent of total ton-miles of freight; more importantly that tonnage accounts for nearly 75 percent of the value of freight shipped domestically.

With the fourth largest land area of any country, the United States is surely the most reliant upon roads and highways. The nation has 8.4 million lane miles (3.2 million miles) of roads connecting metropolitan areas, towns, and counties across the country to serve its 300 million residents and 7 million business establishments.

As valuable and important as highway transportation is, it also faces enormous challenges. For example, demand on the system increased sharply in recent years resulting in the congestion we have become all too familiar with. Total highway travel in personal vehicles, motorcycles, light and heavy trucks totals nearly 3 *trillion* miles annually. Total travel has leveled off in the last couple of years, but it increased 25 percent between 1997 and 2006. Not only is much of the highway system reaching or exceeding its expected service life, it is also carrying a much heavier burden than expected. The amount of traffic on rural Interstates more than doubled between 1970 and 2005, but the loadings placed on those highways, due largely to more trucks traveling more miles, increased six-fold during that period. The system is facing unprecedented challenges in overall demand, safety, the cost of paying for system preservation and operation, and environmental impact. Because there is not enough money to meet all these challenges, research and innovation is desperately needed. For example, we must learn how to reconstruct highways more efficiently at lower cost and do so while continuing to maintain service with minimal disruptions. We must also strive to meet ever-higher standards for providing capacity with minimal disruption to communities and the environment.

AN OVERVIEW OF U.S. HIGHWAY RESEARCH & TECHNOLOGY PROGRAMS

Decentralized Responsibilities

Highway research, like the management of the highway system itself, is highly decentralized, and appropriately so. Roads and highways are owned and operated by the states, thousands of counties, and tens of thousands of cities and municipalities. These many and varied organizations make all the key decisions about investment, operation, and preservation of roads. Aside from the roads on federal lands, the federal government has little direct connection with the pressures of financing, building, maintaining, and operating roads. Doing so is a massive enterprise. Roughly $94 billion is spent every year on roads and highways.

Each state has its own highway research program, and states, in turn are providers of technology and innovation to cities, counties, and municipalities. States' R&T programs often provide the final step in implementing new technologies, and they must meet the particular needs of individual states' soil conditions, climate, and institutional arrangements. Pavement design itself, for example, is highly dependent upon local soil conditions, moisture levels, temperature ranges, and sources of local aggregate. Operational needs range widely between states with major metropolitan areas and states mostly made up of rural areas. State policy concerns about economic development, finance, environmental issues, and safety also vary considerably across states. State research programs support research initiatives in all these areas.

The existence of 52 programs might suggest that duplication would occur, but, in fact, states have a system of sharing resources in order to study topics of collective interest, and the states and federal transportation agencies, through TRB, maintain a database of completed research and research in progress, which states are required by FHWA to consult before initiating new projects. State highway research programs are mostly funded through federal aid. For decades, the federal aid title of surface transportation authorization (Title I) has required states to spend a small percentage of federal aid on planning and research. (The State Planning and Research (SP&R) program currently sets aside 2 percent of selected highway program funding of which 25 percent must be spent on research.) States pool some of their resources in the National Cooperative Highway Research Program (NCHRP), which is managed by TRB on the states' behalf, as described in more detail below.

Federal Role

Even though the federal government has a minor role in owning and operating highways, it plays a virtually indispensible role in the research and innovation process. The federal government funds about two-thirds of total highway research and technology programs (Table 1), plays a critical role in training and technology transfer, and is the sole source of funding for higher-risk, potentially higher-pay off research.

The Federal Highway Administration (FHWA) is the principal agency managing highway research at USDOT. It has research activities in each of its mission-area responsibilities: infrastructure, operations, environment and planning, safety, and policy. Through its research and program office staff in these areas, FHWA interacts with experts and stakeholders in the public and private sectors to develop multi-year program plans for their research and development activities.

The Intelligent Transportation Systems (ITS) research program, initiated and formerly managed by FHWA, is now managed by the Research and Innovative Technology Administration (RITA). The ITS program is multi-modal, but most of the projects and funding are highway-related. In addition, the University Transportation Centers (UTCs) conduct highway research (generally with federal funding); this program is administered by RITA. The UTC program is multi-modal, but 69 percent of the

projects in 2008 were focused on highway topics,[1] hence I have included it as part of the federal investment in highway research. Various private entities fund highway research, but their role is surprisingly small.[2] Because of the large public presence in roads and highways and the nature of public procurement of highway goods and services, there are relatively few opportunities for the private sector to capitalize on private research. Consequently, the share of private funding is small and the public responsibilities for encouraging innovation are large.

Table 1: National Highway Research, Development, and Technology Expenditures, 2006 ($000s)[3]

	Federal	State	Private	Total
FHWA				
Surface Transportation R&D	133,000			133,000
Training & Education	23,000			23,000
RITA				
University Transportation Centers	60,000			60,000
ITS program	96,400			96,400
States	165,800[a]	160,200		326,000
Strategic Highway Research Program 2	36,200[b]			36,200
Associations			25,000-50,000	25,000-50,000
Companies			50,000-100,000	50,000-100,000
Total	512,700	160,200	75,000-150,000[c]	747,700-822,700
Percentage	62-69%	19-21%	10-18%	100-100%

[a]State Planning & Research Funds, Title I of SAFETEA-LU.
[b]Funded from Title V 2005-2006 and Title I in 2008-2009.
[c]Estimated in 2001 in *The Federal Role in Highway Research* TRB Special Report 261, Transportation Research Board of the National Academies, Washington, D.C., 2001.

FHWA is closely connected to the states though its federal aid and RD&T programs and has offices in each state. RITA, in addition to administering the ITS and UTC programs, has a role in strategic RD&T planning for the department. Because of the extent of earmarked research and detailed designations of research programs in the Safe, Accountable, Flexible, Efficient, Transportation Equity Act of 2005 (SAFETEA-

[1] *The Federal Investment in Highway Research 2006-2009: Strengths and Weaknesses*, Special Report 295, Transportation Research Board of the National Academies, Washington, D.C., 2008, p. 75.
[2] *Building Momentum for Change: Creating a Strategic Forum for Innovation in Highway Infrastructure*, Special Report 249, Transportation Research Board of the National Academies, Washington, D.C. 1996, p. 14-15. See also Chapter 6 of *Implementing the Results of the Second Strategic Highway Research Program: Saving Lives, Reducing Congestion, Improving Quality of Life*, Special Report 296, Transportation Research Board of the National Academies, Washington, D.C. 2009.
[3] *The Federal Investment in Highway Research 2006-2009: Strengths and Weaknesses*, Special Report 295, Transportation Research Board of the National Academies, Washington, D.C., 2008, Table 2-2, p. 21.

LU), about which I will say more later, RITA has had limited opportunity to influence the scope and direction of highway research.[4]

A federal role of growing importance is the support for higher-risk, potentially higher pay-off research. TRB has been administering an NRC-appointed expert committee to provide guidance to the FHWA RD&T program since 1992. The Research and Technology Coordinating Committee (RTCC) has consistently encouraged FHWA to invest in this kind of research.[5] The vast majority of the highway research conducted in this country is highly applied, problem-solving research, as it should be. But no agency has been funding more exploratory research that is seeking new understanding that could lead to new breakthroughs. The Exploratory Advanced Research program authorized in SAFETEA-LU is an example of this kind of research and a welcome change. In principle, this kind of research should also be supported through UTC program, but the dollar-for-dollar matching requirement of the UTC program has driven this program to focus on applied research.

Special Initiatives

Over the years stakeholders in the highway community have requested special initiatives to meet special needs. Most of these initiatives have been governed by stakeholders and funded with federal aid and rely on competition and merit review to award contracts and grants.

AASHO Road Test and Long Term Pavement Performance Experiment.

In the late 1950s an extensive series of tests was conducted for the American Association of State Highway and Transportation Officials (AASHTO), then named the American Association of State Highway Officials (AASHO), on a pavement test track. These tests established the empirical relationships between pavement loadings and distress that that became the basis of the first AASHTO pavement design guide issued in 1961, which subsequently determined pavement designs in the United States as well as influencing them around the world. TRB, then the Highway Research Board, administered these tests for AASHO.

The AASHO road test, however, did not adequately account for variations in soil conditions, materials, climate, and other factors that influence pavement deterioration in addition to loadings. The Long Term Pavement Performance (LTPP) experiment, begun 20 years ago, and costing over $260 million in federal funding, will be nearly completed this year. FHWA has managed the experiment in collaboration with the states, which have invested at least double the federal share in constructed pavements and data collection. An NRC-appointed committee administered by TRB has advised FHWA and the states on the conduct of this experiment. The data collected to date have already been influential in implementing the new Mechanistic-Empirical Design Guide being

[4] Committee for the Review of the USDOT Strategic Plan for R&D, Letter Report, August 2, 2006. http://www.trb.org/news/blurb_detail.asp?id=6582

[5] *The Federal Role in Highway Research and Technology*, Special Report 261, Transportation Research Board of the National Academies, Washington, D.C. 2001.

implemented by the states and will likely be as influential in future pavement design as the AASHO road test.

Intelligent Transportation Systems (ITS) program
In the late 1980s a broad-based public-private stakeholder group known as *Mobility 2000* began promoting the need to apply computer and electronic communications technologies to increase the capacity and safety of highways. The research and demonstration program that was initially funded in the Intermodal Surface Transportation Efficiency Act of 1991, has since invested more than $1.2 billion in developing, testing, and implementing ITS technologies. ITS America, an outgrowth of *Mobility 2000*, was originally designated as the formal advisory body for the program; RITA now has a designated ITS advisory committee for this purpose.

Strategic Highway Research Programs (SHRP) 1 and 2.
Originally conceived by an NRC-appointed committee administered by TRB, the first SHRP program was a fixed-duration $150 million research effort focused on materials and maintenance practices that produced significant breakthroughs in asphalt mix design procedures and winter maintenance practices. FHWA, AASHTO, and TRB collaborated in the development of detailed research plans. The program was authorized in the 1987 surface transportation reauthorization legislation. A special unit of the NRC was created to allow for stakeholders governance of the program and convene expert panels to produce requests for proposals (RFPs), provide merit review of the proposals, recommend selection of contractors, and manage the contractors.

In the Transportation Equity Act for the 21st Century, Congress requested that TRB convene another NRC-appointed committee to determine the need for a second SHRP. A committee made up of leaders from the highway community recommended an ambitious program to significantly improve safety, provide capacity in greater harmony with community values and the environment, improve travel time reliability, and renew highway capacity more efficiently and effectively while under traffic.[6] SAFETEA-LU authorized a 6-year, $205 million program for this purpose. Under a three-way partnership with AASHTO, FHWA, and TRB, the program is governed by stakeholders and administered by TRB. Eighty-five percent of the research funds are awarded competitively based on merit review by peers.

National Cooperative Highway Research Program (NCHRP)
Since 1962, under a cooperative agreement among AASHTO, FHWA and TRB, TRB has administered the NCHRP program. In this cooperative program, the states select the topics to be studied through the Standing Committee on Research of AASHTO. TRB then forms panels of experts to issue RFPs, review proposals, select contractors, and oversee the research. TRB administers similar programs for transit agencies (Transit Cooperative Research Program, since 1991), and airports (Airport Cooperative Research Program, since 2005).

[6] *Strategic Highway Research: Saving Lives, Reducing Congestion, Improving Quality of Life*, Special Report 260, Transportation Research Board of the National Academies, Washington, D.C. 2000.

Other Cooperative Research Programs

SAFETEA-LU authorized two relatively small-scale cooperative programs that TRB administers for others. One program, recommended by AASHTO, addresses intermodal freight research issues. Another pilot program, recommended by an NRC-appointed committee convened at the request of USDOT, addresses hazardous materials transportation.[7] As with other cooperative programs, stakeholders provide the governance and TRB provides the administration.

In 2002, an NRC-appointed committee also recommended the creation of a Surface Transportation Environment and Planning cooperative research program.[8] The committee that authored that report was chaired by Betty Deakin, who is also invited to testify today. A key concept behind this proposal was to bring the highway and environmental communities together to govern a research program that would use the best science and technology to address and resolve some of the contentious issues and questions that separate these two constituencies. SAFETEA-LU authorized such a program and left it to the discretion of USDOT whether to manage it directly or have TRB form a stakeholder committee to provide governance of the program. Partly due to the funding constraints SAFETEA-LU imposed on USDOT, FHWA chose to retain the program, which, nonetheless, does have an extensive outreach component.

The structure of the highway research program appears complicated, and it is. The genius of the design, however, is that the programs and initiatives are structured for the most part so that they are close to the various problems they are designed to address. In principle, the various programs provide a portfolio that ranges from highly applied to more exploratory research. In the view of many, the balance is not quite right, and, for the amount of money being spent, there appear to be far too many categories and far too little flexibility to shift program priorities in response to new opportunities, such as nanotechnology, or emerging needs, such as security and climate change.

FINDINGS AND RECOMMENDATIONS FROM RECENT NRC REPORTS

Two NRC-appointed committees have recently completed reports that address the questions posed by the committee. After summarizing the main findings and recommendations of these reports, I respond to the committee's questions more directly.

Last November the NRC released the RTCC report entitled *The Federal Investment in Highway Research 2006-2009: Strengths and Weaknesses*. This report evaluates the federal highway RD&T programs in terms of the principles for research that are articulated by Congress in the introduction to Title V of SAFETEA-LU. Some of

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[7] *Cooperative Research for Hazardous Materials Transportation, Defining the Need, Converging on Solutions*. Special Report 283. Transportation Research Board of the National Academies, Washington, D.C., 2005.

[8] *Surface Transportation Environmental Research: A Long-term Strategy*. Special Report 268. Transportation Research Board of the National Academies, Washington, D.C., 2002.

these principles are based on recommendations made by the RTCC in is 2001 report, *The Federal Role in Highway Research*. These principles address

- the scope of the federal RD&T program;
- when federal investment is justified,
- the content of the program, including fundamental, long-term research; gap-filling research; and policy or planning research;
- stakeholder input;
- awarding R&D funds primarily through competition and peer, or merit, review; and
- Evaluation of research.

The main findings of the RTCC are as follows:

- Despite the progress made in overall funding in SAFETEA-LU, highway research programs are significantly under funded compared with the level of R&D investment in private industry. Public and private highway research is funded at only 25 percent of the level of industrial R&D in the United States (0.9% of highway expenditures compared to 3.4% of industrial sales).

- The research programs funded in SAFETEA-LU meet the Title V principles with these main exceptions:

    - Extensive earmarking (62 percent) of the University Transportation (UTC) Program and additional earmarks scattered across FHWA programs (equal to at least 18 percent of total funding) violate the SAFETEA-LU principle of awarding research funds according to competition and merit review.

    - The programs funded in SAFETEA-LU do not include all the content areas Congress requested. Due to funding constraints in Title V caused by a considerable number of narrowly-designated programs and earmarking of more programs than were authorized, FHWA was forced to cut important areas of research in safety, operations, planning and environment, and policy. Funding for research and data gathering to support policy decisions was eliminated and funding for planning was greatly reduced. Other areas that are funded, such as deployment and technology transfer, are nonetheless inadequate to the task.[9]

    - The 50-50 matching requirement for the UTC program biases this program toward highly applied research and away from advanced research that is one of the main rationales for having a university research program.

[9] SAFETEA-LU technical corrections legislation of 2008 restored some of FHWA's lost funding and gave the agency discretion over about an additional $14 million annually.

- Due to funding constraints, FHWA has inadequate funds to carry through on commitments it has made in its *Corporate Master Plan for Research, Deployment and Innovation* to engage stake holders more broadly in agenda setting, merit review, and program evaluation.

- The SHRP 2 program meets all the research principles, but is funded at only one-third the level and for two years less than stakeholders requested. The down-scaled program will not be able to meet all the original goals envisioned.

The committee also makes several important recommendations.

1. To the maximum extent practical, research funding should be awarded through competition and merit review.

2. All UTC funds should be awarded to universities competitively. The 50-50 matching requirement for UTC research should be reduced to a 20 percent university match to allow universities to conduct more advanced research.

3. The Exploratory Advanced Research program should be continued.

4. The State Planning and Research (SP&R) program should be continued.

5. Cuts in policy, safety, operations, and planning and environmental research at FHWA should be restored. Funding for research and data gathering to inform policy decisions should be increased to meet pressing national needs. The surface transportation environmental and planning research program should be authorized as a cooperative research program in which the stakeholders are enabled to govern the program. In the planning area, additional funding for expanded data collection and improving regional travel forecasting models should be provided.

6. Congress should consider extending the SHRP 2 program for 2 years into the next authorization and funded under Title I. (Under Title I, the funding would come from states' construction budgets, which they have approved.)

7. Other research programs strongly supported by stakeholders responsible for administering highways, such as the Long Term Pavement Performance Program[10] and the Long Term Bridge Performance Program should be continued.

[10] The recently issued NRC report, *Preserving and Maximizing the Utility of the Pavement Performance Database*, Transportation Research Board of the National Academies, February 2009, recommends completing the data collection from the 500 or so highway sections of the LTPP experiment that will still be providing important information at the end of 2009 and establishing a permanent database to allow researchers to mine these data and complete the analysis originally envisioned for this experiment, which has not been conducted due to funding constraints.

8. Adequate resources should be provided to FHWA for a robust program for deployment of research results to states, local governments, and private vendors.

9. Resources should be provided to FHWA to institute a process of ongoing priority setting for highway research that engages the entire highway community. The results of these efforts would inform all highway research programs and improve the ability of all programs to focus efforts on the highest priorities.

A second NRC committee has recently recommended a deployment program that would implement the results of the SHRP 2 program in its report, *Implementing the Results of the Second Strategic Highway Research Program: Saving Lives, Reducing Congestion, Improving Quality of Life.*

The committee recommends that a large-scale deployment effort totaling $400 million over 6 years be carried out by FHWA in partnership with AASHTO, the National Highway Traffic Safety Administration (NHTSA), and TRB. The committee also recommends that

- this implementation effort be guided by advice from a formal advisory committee made up of key stakeholders who must implement the results from SHRP 2 and
- detailed, publicly-available implementation plans be developed with stakeholder input.

I include these recommendations of this report because the large-scale, organized deployment program envisioned provides a model for how FHWA should be organizing itself to support the delivery of innovation. The RTCC report calls for funding a "robust" program of deployment and this is certainly an example of a robust program. It has to be. Innovation in the highway sector is challenging. The largely public-sector highway field results in an extremely risk-averse environment. The barriers to innovation are high. The procurement of highway goods and services is highly detailed and specified as public procurements often must be. There are severe penalties for failures and few rewards for success. The key concepts of this committee's proposal are its guidance by stakeholders, its degree of organization and dedication, and the scale of funding necessary to deliver results to overcome the barriers to innovation.

RESPONSE TO QUESTIONS POSED BY THE COMMITTEE

1. How are R&D priorities developed and coordinated within DOT and how are they aligned with the needs of the user community? What is your assessment of these priorities? Do we need to change any R&D priorities to address major challenges such as environmental impact and energy consumption?

R&D Priorities

SAFETEA-LU charged RITA with preparing a multimodal strategic 5-year RD&T plan and required that the plan be reviewed by the National Research Council. The 5-yr plan

was released in 2006.[11] An NRC committee reviewed this plan and found that it was best described as a summary of what research the various modal administrations were funding rather than a true strategic plan.[12] There are important reasons why this plan was not truly strategic from a top-down perspective. First, the research titles of SAFETEA-LU contain numerous narrowly-defined designations and many R&D activities are earmarked to specific recipients. These designations and earmarks exceed the amount authorized, which effectively removes agency discretion in shifting resources to respond to USDOT priorities. Second, as a practical matter, most of the needed research identified by stakeholders is truly modal in character. Pavements and structures, for example, are such a large share of highway agency responsibilities and expenditures that it is natural that FHWA would conduct extensive research in these areas with an interest and focus not shared by other modal administrations. Safety is another important area for FHWA, and its areas of highway safety responsibility are well delineated and distinct from those of NHTSA and the Federal Motor Carrier Safety Administration. Finally, the ability of USDOT to direct or control the research programs from a top-down perspective is in a natural tension with the efforts of the modal administrations to be responsive to the "bottoms up" needs for research identified by stakeholders. It is appropriate for USDOT to set broad goals and objectives for the RD&T program, allocate resources according to direction set by Congress, support advanced research, and conduct mission-critical research for federal regulation and oversight. FHWA should be taking more of a leadership role in developing research priorities in concert with the entire highway community. Because USDOT is so disconnected from responsibilities of actually delivering and operating infrastructure, however, the federal RD&T program should be largely driven by stakeholders.

Alignment with needs of user community

The research programs of the modal administrations reach out to stakeholders to inform their selection of research priorities and projects. As mentioned previously, TRB has expert committees reviewing the research programs of FHWA, FTA, and FRA as well as committees of experts reviewing the FHWA's pavement research and deployment activities and the conduct of the Long-Term Pavement Performance experiment. TRB also manages the SHRP 2 research program, which was identified and is governed by stakeholders. The FAA has an extensive advisory committee structure for its aviation research program.

The FHWA probably has the most extensive interactions with stakeholders, as described in some detail in Chapter 5 of *The Federal Investment in Highway Research 2006-2009: Strengths and Weaknesses*. FHWA's different R&D offices for infrastructure, operations, safety, and planning and environment have varied outreach efforts to different constituencies, including AASHTO committees, Metropolitan Planning Organizations (MPOs), industry associations, public-private consortia, standing committees of TRB's Technical Activities Division, environmental and safety groups,

[11] *Transportation Research, Development and Technology Strategic Plan, 2006-2010*. U.S. Department of Transportation, Research and Innovative Technology Administration.
[12] Committee for the Review of the USDOT Strategic Plan for R&D, Letter Report, August 2, 2006. http://www.trb.org/news/blurb_detail.asp?id=6582

and others. The program and research offices have developed multi-year R&D program drawing on stakeholder input. Moreover, FHWA has committed to working even more extensively with stakeholders in its *Corporate Master Plan for Research, Deployment and Innovation*, although the RTCC notes in its 2008 report that because of the constraints in Title V, FHWA has not had the discretionary resources to carry out the commitments it made. Despite FHWA's extensive and varied outreach to stakeholders, however, it is fair to say that FHWA could do more to make these activities more transparent to others. Many of the interactions between research and program offices and various stakeholder groups are carried out informally. FHWA should be communicating via its website the opportunities for stakeholders to participate in the shaping of its program, documenting the input it has received, and posting its multi-year research program roadmaps. FHWA is clearly listening to and working with stakeholder groups and most of its R&D programs and initiatives within these programs are aligned with stakeholder interests. Because the Federal Transit Administration's program is so heavily earmarked, it has relatively little discretion over what research it conducts, but its research office should be reaching out to the American Public Transportation Association and other transit industry stakeholders in the ongoing development of its strategic RD&T plan.[13] Much of the Federal Railroad Administration's R&D program is safety-oriented research driven by its safety regulatory mission, but it also could be more attuned to research the states and passenger and freight rail industries would benefit from.[14]

Changing Priorities

The TRB Executive Committee recognized in mid 2008 that the surface transportation research proposals for reauthorization being developed by various groups were deficient in not recognizing the growing importance of reducing transportation greenhouse gas (GHG) emissions and energy consumption. TRB has self-initiated studies under way that we anticipate will make recommendations to Congress before SAFETEA-LU expires regarding research in climate change mitigation and adaptation and will identify policy options for reducing transportation energy consumption and GHG emissions.

Despite what I anticipate will be recommendations for dedicated research in the areas of climate change and energy conservation, I hesitate to recommend cutting existing programs to shift funds to these areas. The RTCC report notes that highway research is significantly underfunded. The share of annual revenues devoted to highway research is only one quarter as large as industry generally and comparable to the lowest of the low-technology sectors of industry. But the challenges faced in the highway sector are among the most complex and important of society. We have a sunk investment in infrastructure worth well over a trillion dollars that has to be maintained. We lose more than 40,000 people each year in traffic crashes. The motor vehicles that use the highway system burn petroleum-based fuels almost exclusively and are a main source of our dependence on imported oil. We must find a funding mechanism to replace or

[13] Transit Research Analysis Committee, Transportation Research Board of the National Academies, Letter report of May 4, 2007. Washington, D.C.. http://onlinepubs.trb.org/onlinepubs/reports/trac_may_2007.pdf

[14] Committee for the Review of the Federal Railroad Administration Research and Development Program, Letter report of April 29, 2008. Transportation Research Board of the National Academies. http://onlinepubs.trb.org/onlinepubs/reports/frar&d_April_2008.pdf

supplement the gasoline tax as the mainstay for funding highway and transit programs. And highways are significant sources of negative environmental impact. Because we are also so heavily dependent on highways to serve our economy and society, the need for innovation to address these problems has never been greater.

2. How would we improve our transportation R&D investment structure?

R&D Investment Structure

In concept, the portfolio of programs funded through SAFETEA-LU is appropriate, but the program is far more detailed than necessary. In an ideal world, the programs would mirror FHWA's mission, goals, and operational areas (infrastructure, operations, safety, planning and environment, and policy) with flexibility for the agency to be responsive to new issues and stakeholder input. FHWA's share of Title V, Surface Transportation Research and Technology Deployment, has 42 line items to allocate $130 million, many of these line items are at the research project level. Compare that to NSF, which has a budget in excess of $6 billion and roughly the same number of line items.

There are several federally-managed programs funded through Title V that are clearly aligned with stakeholder interests; the state programs are supported through the State Planning and Research (SP&R) provisions in Title I; special initiatives such as the fixed-duration Strategic Highway Research Programs have been funded from time to time; and support for university-initiated research is provided through the University Transportation Centers Program.

A principal weakness in the portfolio is the scant funding for advanced, or longer-term, higher-risk research. The creation of the Exploratory Advanced Research Program (EARP) in SAFETA-LU is a step in the right direction. In its 2001 report, the RTCC recommended that 25 percent of the FHWA program be devoted to "longer-term, higher-risk" research. Applied research is the central element of the federal program, and it should be, but it is also incremental in nature. Such research is unlikely to result in breakthroughs that can transform practice. At present the EAR program represents about 6 percent of FHWA's overall program. It is a good start, but far from the goal the RTCC has suggested.[15]

The RTCC's 2008 report recognizes the role that the UTC program could be playing in advanced research. Universities are ideally suited for creating new knowledge and understanding, and the UTC program is one of the few surface transportation research programs that can fund investigator-initiated research. The RTCC finds, however, that the UTC program is mostly conducting applied research. A scan of highway research projects under way in the UTC program indicates that at least 80

[15] There are earmarked programs that are addressing, in part, advanced research in asphalt. The RTCC, however, recommends that advanced research conform to the principles Congress established in Title V – that funds be awarded based on competition and merit review of proposals by peers.

percent are highly applied.[16] The RTCC concludes that the dollar-for-dollar matching requirement of the UTC program drives it toward applied research. Most of the providers of matching funds are state DOTs, which they typically provide from SP&R funds, and they tend to want their SP&R funds devoted to solving the many immediate problems they face. An important reform of the UTC program recommended by the RTCC is to change the matching requirement to a 20 percent university match. This would free up universities to devote more of their available funding to the kind of advanced research the program was created to conduct in the first place. At the same time, of course, the UTCs should be selected competitively, rather than having 62 percent earmarked.

Another weakness of the structure of the program is the relative neglect of policy research. Many important transportation policy questions are going uninvestigated because of lack of any funding for this purpose, forcing infrastructure owners to make decisions while ill informed. This is the kind of research that ought be conducted to guide decisions about intermodal investments, such as inter-city passenger rail, improved highway access to ports, short-sea shipping, and policies to enhance the effectiveness of transit. The lack of policy relevant research significantly hampered the work of the two commissions Congress created in SAFETEA-LU to advise it on, among other things, the future viability of motor fuels taxes to fund highway and transit infrastructure. Gaps in knowledge about how sensitive travelers are to rising fuel prices and increased congestion, or how freight traffic might switch modes for these same reasons, for example, undermine confidence in projecting future revenue streams for the highway trust fund, which is one of the key policy concerns for reauthorization of the highway program in 2009. Policy funding was reduced to almost zero as a result of the over-designation and earmarking of funds in Title V. Funding that had been about $9-10 million annually was eliminated. Last year's technical corrections legislation helped, but restored but $1 million annually for the Office of Policy.

Much greater emphasis on data collection is also necessary. Being able to answer many of the most important policy questions in highway transportation requires much better data. Research in the planning area to develop the advanced modeling tools needed to meet federal and local planning and environmental mandates also require better data. States and MPOs rely heavily on the National Household Transportation Survey, which was dropped by the Bureau of Transportation Statistics (BTS), whose funding was also sharply reduced in S-LU. (Fortunately FHWA and other administrations within USDOT have stepped in to provide stop-gap funding to maintain this critical survey.) Similarly, improved, and more timely, data on freight movements is essential for improved planning; the Commodity Flow Survey, which is still part of BTS's portfolio but nonetheless underfunded, should be sustained and enhanced to meet user requirements.

Proposals already circulating that address reauthorization of the surface transportation program, including the reports of both SAFETEA-LU commissions, recommend that the federal-aid program become performance based. A true system of

[16] *The Federal Investment in Highway Research 2006-2009: Strengths and Weaknesses*, Special Report 295, Transportation Research Board of the National Academies, Washington, D.C., 2008, p. 76.

performance measures will create enormous new demand for better data on inventory condition and value, real-time system performance, safety, environmental protection, and other performance metrics.

Technology transfer is another area of weakness, as I explain in response to question 3.

3. How can we improve the transfer of transportation technology from the R&D stage to deployment and adoption in the field? As we prepare for major investment in infrastructure, how do we ensure that the latest proven technologies are utilized?

Deployment of new technology and practice does not receive the attention it deserves. It is important to recognize, however, that FHWA does carry out considerable technology transfer activities. FHWA has extensive information on its program office web pages about new techniques, as well as technical briefings, manuals, and implementation guidance. These activities are partially funded with R&D funds. FHWA also administers the Local Technical Assistance Program (LTAP) and offers training on new technologies and practices through the National Highway Institute. FHWA's field offices in every state are also sources of information for state practitioners. These activities, however, are not sufficient.

FHWA formerly had resources explicitly devoted to technology transfer, which were lost in 1998 in TEA-21, and the office that had specialized in this activity was subsequently disbanded.[17] FHWA then allocated technology responsibilities to program offices in concert with the office of research and technology, but this responsibility was added to other responsibilities of FHWA's existing staff. The barriers to innovation, however, are high and the expertise required for successful technology transfer requires a strategic plan, dedicated and expert staff, and adequate resources to overcome these barriers.[18] The SHRP 2 implementation report provides a model of what is required to assist the states in deploying new technologies and practices. In addition, the RTCC's report indicates that adoption of innovations may require incentives that reduce the risk of trying something new. FHWA used to have resources, for example, that would allow 100 percent federal funding for implementing promising, but not quite fully proven, technologies or techniques.

4. What are some of the lessons learned from the last reauthorization of the highway bill (SAFETEA-LU)? What improvements can we make?

The principles for research articulated in the preamble to Title V of SAFETEA-LU are good ones and I hope they will be retained and followed. They encourage stakeholder

[17] *Managing Technology Transfer: A Strategy for the Federal Highway Administration*, Special Report 256, Transportation Research Board of the National Academies, Washington, D.C. 1999.
[18] *Implementing the Results of the Second Strategic Highway Research Program: Saving Lives, Reducing Congestion, Improving Quality of Life*, chapters 6 and 7.

involvement, competitive award of funding based upon merit review, advanced research, and a federal program that spans the entire innovation process. There are, however, too many designated programs and earmarks in SAFETEA-LU that constrain FHWA and RITA from carrying out a research programs consistent with these principles, reduces funding to core mission activities of FHWA, and deny the agencies flexibility in responding to emerging issues and the needs of stakeholders.

In terms of other improvements, I refer back to the committee recommendations from the two reports summarized in the previous section.

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